THE EXCRETORY SYSTEM OF *AGAMODISTOMUM MARCIANAE* (LA RUE), THE AGAMODISTOME STAGE OF A FORKED-TAILED CERCARIA *

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In a recent paper La Rue (1917) described as *Cercaria marcianae* a new larval trematode from *Thamnophis marciana* (Baird and Girard). Since this form is in the agamodistome stage, the species should be referred to the provisional genus Agamodistomum Stossish and the name changed to *Agamodistomum marcianae*. In the summer of 1915 I collected material of this same species from the tissues and lymph spaces of tadpoles of *Rana pipiens* and *Rana clamitans,* and from the digestive tract and body cavity of the garter-snake, *Thamnophis sertalis,* from the region of Douglas Lake, Michigan. It was found possible to introduce these larvae into the snakes by feeding them with infected tadpoles, but no advance in development followed, and the larvae soon made their way out from the intestine into the body cavity and tissues. This observation and La Rue's description of *Agamodistomum marcianae* from a snake show that this species has two secondary intermediate hosts. Since tadpoles formed a very large part of the food of the garter-snakes examined, it seems very probable as suggested by La Rue (1917:8) that the snakes obtain their infection from this source. This makes a very unusual complication in the life-history of this trematode involving a change of host without an advance in development. I have also found *Agamodistomum marcianae* in lymph spaces under the skin of adults of *Rana pipiens* from North Judson, Indiana.

The host in which *Agamodistomum marcianae* completes its development is not known. Also its structure at this stage gives little clue to the systematic position of the adult. The character of its cephalic glands and excretory system, however, indicates that it has developed from a forked-tailed cercaria, and a comparison of its structure with that of *Cercaria emarginatae* Cort and *Cercaria douglasi* Cort (see Cort, 1917) shows such close correspondence in the structure of the digestive and excretory systems and in the characteristics of the spination, suckers and cephalic glands that a very close relationship is established. Differences from *Cercaria emarginatae* in the number of cephalic glands and from *Cercaria douglasi* in the structure of the excretory bladder makes it impossible to connect *Agamodistomum marcianae* with either of these species. I should expect, however, to find the cercaria of this species to be very much like these two cercariae.

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Except for the arrangement of the cuticular spines my studies on *Agamodistomum marcinae* agree with La Rue's description. I am able to add to his account a complete analysis of the excretory system, made from the study of large numbers of living specimens. The excretory system of this species is of especial significance since it gives an idea of the development of the type of excretory system found among the forked-tailed cercariae.

La Rue's (1917:4) account of the arrangement of the cuticular spines in *Agamodistomum marcianae* is as follows: "The surface of the body is covered with minute spines arranged in regular longitudinal rows. The spines at the anterior end of the body are a trifle longer

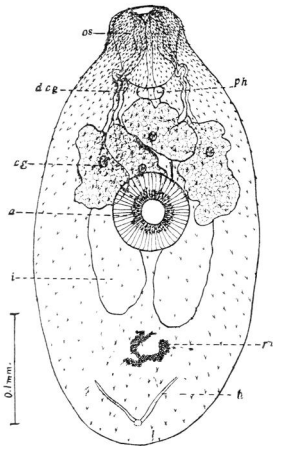

Fig. 1.—Camera lucida drawing of *Agamodistomum marcianae* (La Rue), ventral view; *os,* oral sucker; *ph,* pharynx; *a.* acetabulum; *dcg,* ducts of cephalic glands; *cg,* cephalic glands; *i,* intestinal cecum; *b,* excretory bladder; *r,* primordia of reproductive organs.

than elsewhere." My studies on the arrangement of the spines in living specimens of this species and from toto mounts of my own material and of material sent me by La Rue make necessary a revision of his account. The ventral surface is completely covered with spines which are very thickly set over the anterior tip and somewhat scattered in the postacetabular region. The margin of the acetabulum is armed with two to three rows of closely set spines pointing in, which are so placed that they add greatly to the gripping power of the sucker. The dorsal surface has the same distribution of the spines as the ventral to the region of the bifurcation of the intestinal caeca, but back of this level the cuticula is smooth except for a few scattered spines near the posterior tip. Figure 1 shows the distribution of spines on the ventral surface of *Agamodistomum marcianae.*

In the description of the excretory system of *Cercaria marcianae* the names of the subdivisions as used by Looss (1894: 156) will be employed. This writer divides the trematode excretory system into four main subdivisions which he considers to be natural and recognizable in all forms. They are (1) the excretory vesicle or bladder; (2) the collecting tubes; (3) the capillaries, and (4) the flame cells. The bladder is the region next to the excretory pore, and is the only part of the system which has a definite cellular lining and muscle layers. The collecting tubes connect the bladder with the capillaries. The collecting tubes which flow directly into the bladder, which for convenience may be called the main collecting tubes, are often divided

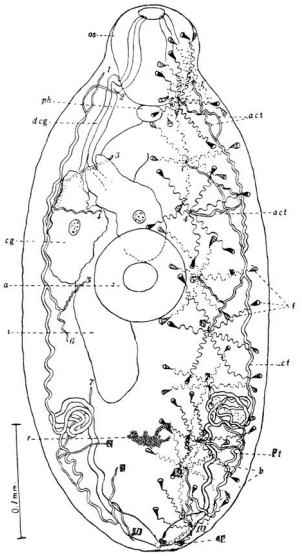

Fig. 2.—Excretory system of *Agamodistomum marcianae* (La Rue), ventral view. On the right side of the figure all parts of the excretory system are shown, but on the left side the capillaries and flame cells are omitted. The numbers 1 to 10 on each side indicate the points where the accessory collecting tubes are joined by the capillaries; letters as before; also, *act,* accessory collecting tubes; *f,* flame cells; *ct,* main collecting tubes; *e,* excretory pore.

and subdivided, a reduction in caliber following division. For convenience also the collecting tubes are divided by Looss into the principal collecting tubes and the accessory collecting tubes. The latter include those which are directly connected with capillary groups. The capillaries are the tubules from the flame cells, and are usually arranged in groups of a definite number.

Figure 2 shows the excretory system of *Agamodistomum marcianae.* On the right side of the figure all parts of the system are shown, while on the left side the flame cells and their capillaries are omitted. The numbers 1 to 10 on each side indicate the points where the accessory collecting tubes are joined by the groups of capillaries.

The excretory pore (*e p*) is at the posterior end slightly dorsad in position and forms the only point of union of the lateral halves of the system. The bladder (*b*) is V-shaped, the sides extending about half way up to the acetabulum, where they form complicated coils. Near the pore the bladder on each side is dilated for a short distance. It is in these dilated portions that the contraction and expansion having to do with the expulsion of fluid is most noticable. Each side of the bladder receives an anterior and posterior main collecting tube (ct). Each anterior main collecting tube receives three branches each of which is divided into two accessory collecting tubes (*act*), while each posterior main collecting tube receives two branches each of which is divided into two accessory collecting tubes. This makes a total of five pairs of accessory collecting tubes on each side (numbers 1 to 10). Each of these accessory collecting tubes receives the capillaries from six flame cells. One accessory collecting tube of each pair with its group of capillaries is dorsal in position and the other is ventral. In

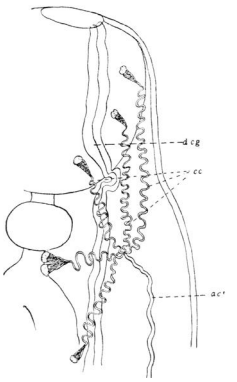

Fig. 3.—Group of flame cells and capillaries at the anterior end of *Agamodistomum marcianae* (La Rue), showing a flame cell in the process of longitudinal fission; letters as before.

Figure 2 the capillaries and flame cells of the dorsal side are shown with dotted lines. There is then a total of one-hundred and twenty flame cells, connected by their capillaries in groups of six with ten pairs of accessory collecting tubes. The only variation from the pattern just described was found in the capillary group shown in Figure 3, in which one of the accessory collecting tubes of the anterior end is joined by only five capillaries. At the end of one of these capillaries was a flame cell apparently in the process of longitudinal fission. This observation is suggestive of a possible method of formation of capillary groups. Altho I searched carefully for further evidence on this point no other instances of such division were found.

The comparison of the excretory system of *Agamodistomum marcianae* with that of the closely related forked-tailed cercaria *Cercaria emarginatae* (Cort, 1917, Fig. 2 B), gives an idea of the method of

development of this type of excretory system. The general pattern of the two systems is the same, but the subdivisions are much more complicated in the agamodistome. The divisions of the main collecting tubes correspond in number and position in both forms. In *Cercaria emarginatae* these ten subdivisions end in flame cells and are therefore equivalent to capillaries, while in *Agamodistomum marcianae* with increased body size there is need of an increased number of flame-cells, and the ten divisions of the main collecting tubes are bifurcated into twenty accessory collecting tubes, each receiving the capillaries from six flame-cells. Since *Agamodistomum marcianae* does not belong to the same species as *Cercaria emarginatae* it cannot be argued that its excretory system is necessarily derived from one exactly like that of this cercaria. Yet the structural agreement between these two species indicates such close relationship and the homologies of their excretory systems are so striking, that when the conservativeness of the trematode excretory system is considered, it seems certain that the above comparison shows in a general way what is to be expected in the development of the type of excretory system of the forked-tailed cercariae. It is interesting to note that these observations agree in with the theory of Looss (1894; 248-251) as to the method of development of the trematode excretory system. However, the total available data on the whole subject of the development of the trematode excretory system is so limited that any adequate attempt to establish general principles must await an increase in knowledge.

SUMMARY

1. The larval trematode described by La Rue from *Thamnophis marcaiana* as *Cercaria marcianae* should be named *Agamodistomum marcianae*.

2. The excretory system of this species is very complicated consisting of sixty flame cells on each side arranged in a very definite pattern.

3. The finding of a flame cell in one of the groups dividing by longitudinal fission suggests that the capillary groups may be formed by such divisions.

4. *Agamodistomum marcianae* is the agamodistome stage of a forked-tailed cercaria, and its excretory system gives an idea of the development of the excretory system in this group.

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